



California Grower's Perspective on climate change adaptation strategies

*California and Chile - Exploring on-farm climate change
adaptation strategies*

California Department of Food & Agriculture

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Farming in the Salinas Valley

- Top crops: leaf & head lettuce, strawberry, broccoli, nursery, wine grape
- 75,000 jobs
- Gross production value of \$4.25B
- \$2.5B additional economic output



CATEGORIES	2016	2015
Vegetable Crops	\$2,817,031,000	\$3,261,521,000
Fruit & Nuts	\$1,056,777,000	\$1,012,977,000*
Nursery Crops	\$276,423,000	\$313,689,000
Livestock & Poultry	\$80,465,000	\$91,228,000
Field Crops	\$20,947,000	\$20,748,000
Seed Crops & Apiary	\$4,429,000	\$4,980,000
TOTAL	\$4,256,072,000	\$4,705,143,000*

Gross crop value (not net) Monterey County 2016 Crop Report: <http://www.co.monterey.ca.us/>

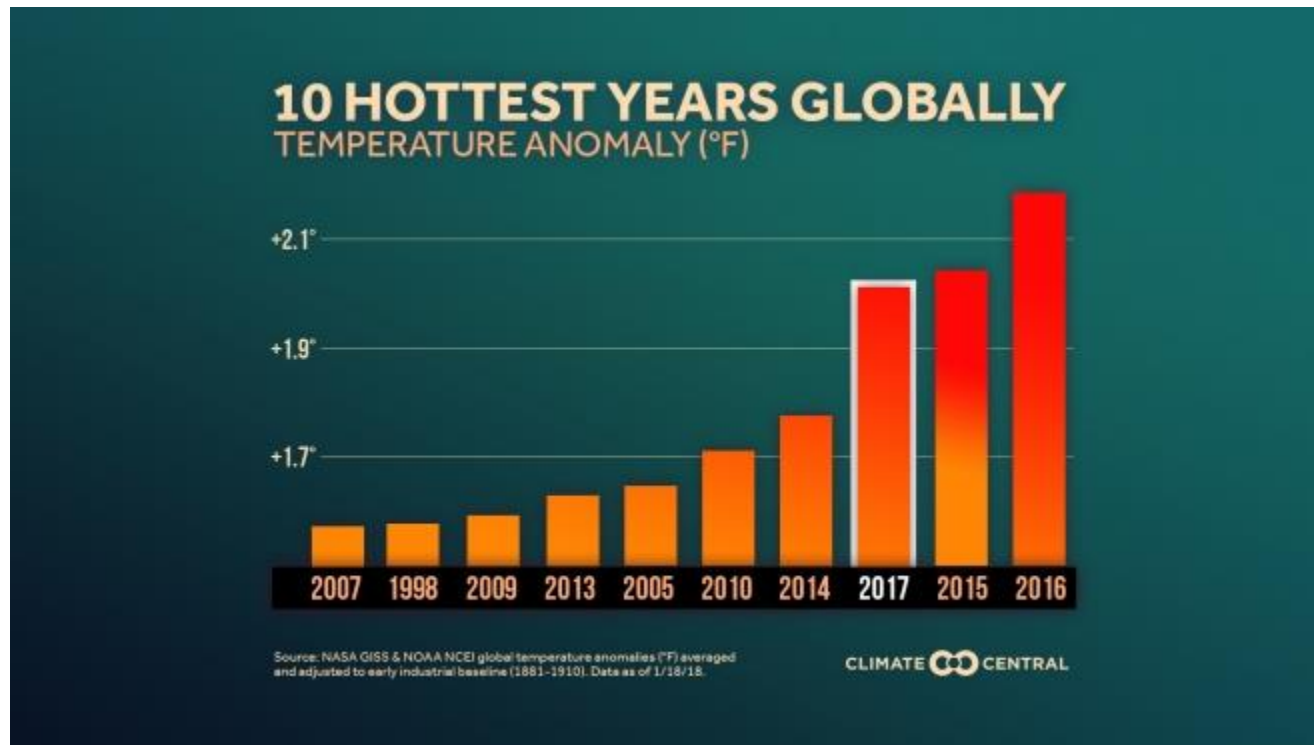
Farming in the Salinas Valley

- High land value, high value crops
- 2-3 crops/year
- CA and AZ production year-round
- Water: primarily groundwater, fed by 2 dams.
- Land tenure – rent vs. own



Recent Temperature Records

- 9/2/17 heat record: Salinas 107F (42C), King City 115F (46C)
- 5 warmest years globally: 2010-2018
- 10 warmest years: 1998-2017
- 20 warmest years: 1995-2017



NASA/NOAA data analyzed at:

<http://www.climatecentral.org/gallery/graphics/the-10-hottest-global-years-on-record>

Some climate-related challenges

- Planting schedules harder to predict
- Erratic weather during seedling stage or harvest
- Farmworker safety on hot days
- Arizona > California production issues
 - Moving equipment and staff
 - Unpredictable winter weather in AZ
 - Early spring harvest in CA

Crop-related Adaptations

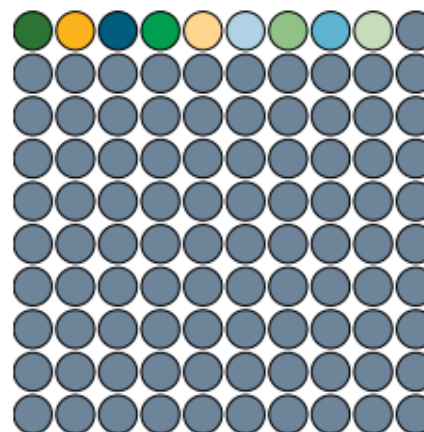
- Crop diversity
- Crop breeding
 - Heat resistant
 - low chill hour req.
 - disease resistant
- Shift production to northern locations
- Replace perennial crops with annual crops
- Get out of the farming business and rent land



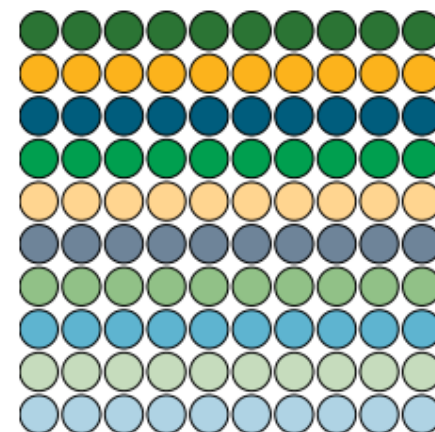
Example: Crop Rotation

Figure 6: Agricultural Economic Diversity is More Than Just the Number of Crops

County "A"
10 Crops, \$100 million
MINIMUM Diversity



County "B"
10 Crops, \$100 million
MAXIMUM Diversity



- Over 100 Crops grown in Monterey County
- Good for pollinators
- Lower pesticide use
- Increases soil biodiversity
- Legumes to fix nitrogen
- Mustards as natural fumigants
- Different root depths - efficient nutrient harvesting
- Higher yields
- Economically sustainable for growers - beat “bad” markets

Image from Monterey County Ag Commissioner:

<http://www.co.monterey.ca.us/home/showdocument?id=1545>

Example: Crop Change



“Apples, like other deciduous fruits, need a known amount of chilling. This differs by varieties. However **this will be the second year in four with insufficient chilling.** The result is a bloom that lasts all summer, reducing the fruit set in the spring.

It makes for a difficult financial proposition to replant an old orchard. **At least the old apple farmer can rent out the land, for more than his harvest net,** so there will be more berries.”

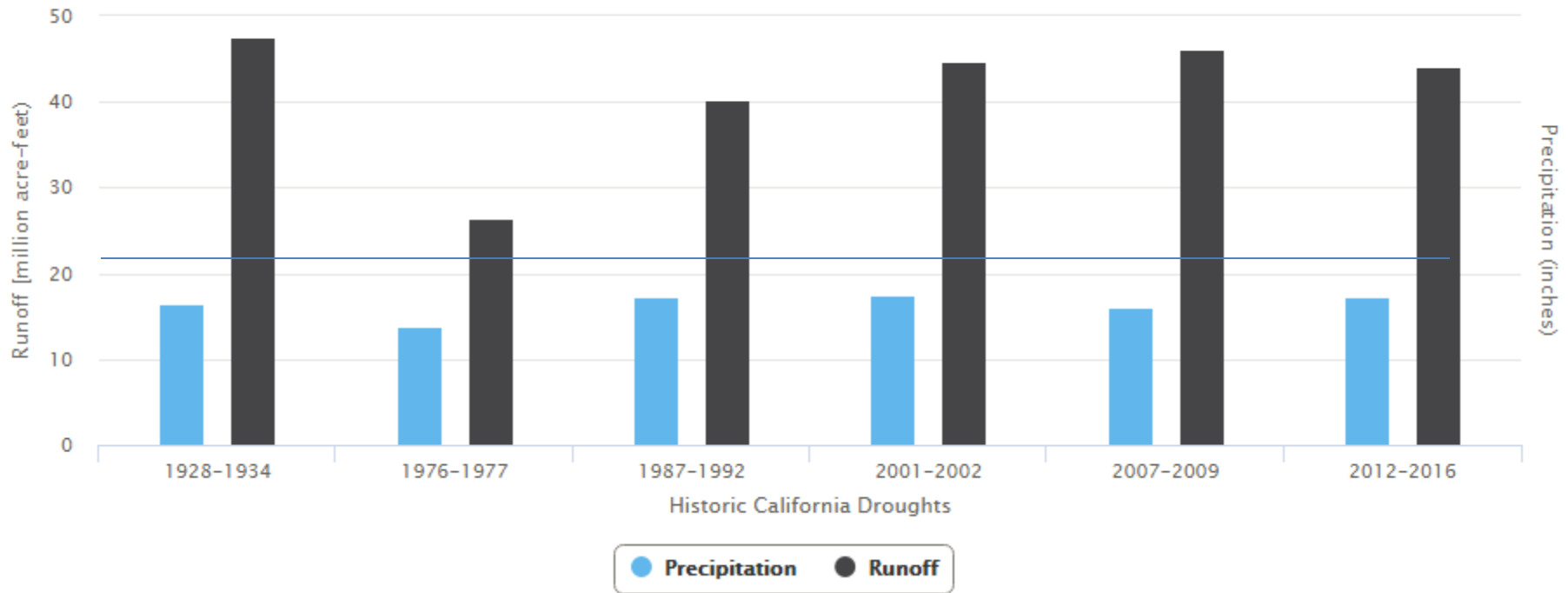
– Apple grower

Water-related challenges

- Droughts
- Floods
- May need more water in future – even without expansion of acreage
 - For plant evapotranspiration
 - For leaching requirement due to salts

Droughts in California

Average Annual Runoff and Precipitation for Historic Droughts



Highcharts.com

- 4 of the 6 major droughts in the past 90 years have occurred in the past 31 years
- 8 of the past 11 years have been drought years in California
- Mean precipitation is 22.45 inches for the period from 1901 through 2000.

Adaptation: Soil Water Storage

- Compost, cover cropping, crop residue management
- Increases water holding capacity
- Increases infiltration to groundwater
- Builds soil organic matter, sequesters carbon, feeds microbes, reduces erosion, nutrient source



Adaptation: Technology



- Soil moisture sensors
- Water meters
- Drip Irrigation
- Irrigation Uniformity tests
- Soil, plant tissue, water sampling



Adaptation: Diversify Sources

- Groundwater
 - Natural infiltration
 - Groundwater recharge basins
- Surface Water
- Recycled Water
- Re-using tailwater on farm

Adaptation: Groundwater Recharge

- North Fork of the Kings River
- Floodwater agreement with Kings River Water Association – can take water when remainder of their districts are in excess flows.
- 2011 & 2017: turned off deep wells, flooded crops with 13 AF/acre of water between February and June
- Years of permitting and approvals

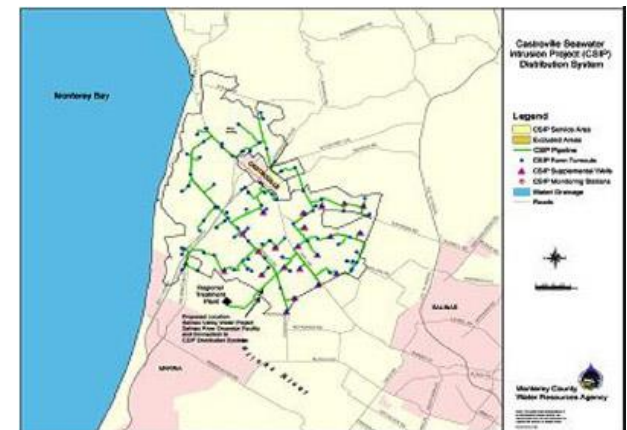
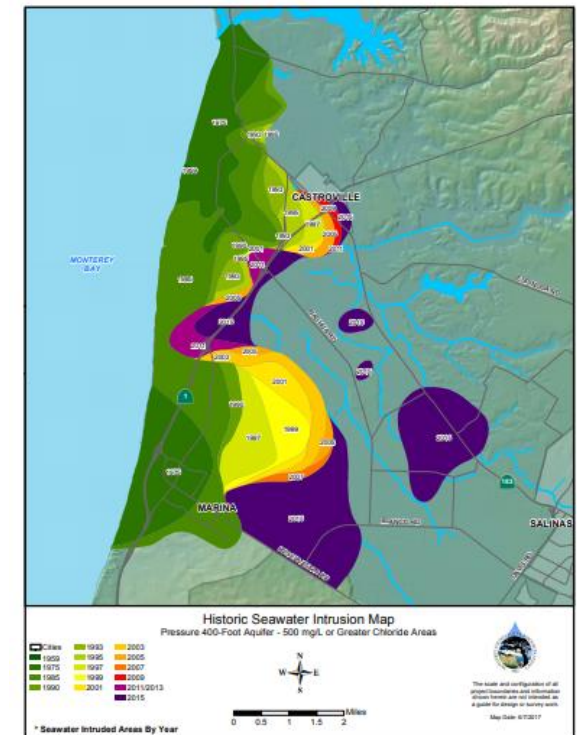


- Crops Inundated: wine grapes, almonds, pistachios, walnuts and olives for oil
- No major crop issues, except grapes when air temps $>90^{\circ}\text{F}$.
- Wind could pose problem to trees.



Adaptation: Use Recycled Water

- Castroville Seawater Intrusion Project (CSIP)
- Purpose: to slow/reverse seawater intrusion
- 1995-98 construction
- 45 miles (72km) pipeline + 22 wells
- 12,000 acres (4865 ha)
- 11,000 AF/year
- Extensive testing to ensure food safety



Pest control challenges

- Increased pest pressure > increased pesticide use?
- Invasive species that prefer warm weather
- *Arundo* & other invasive weeds in riparian areas taking up ground and surface water
- Mild off-season temperatures > pests can over-wintering in region rather than migration or death

Example: Bagrada Bug

- *Bagrada hilaris*
- Est. 2008 in LA, 2013 in Salinas
- Piercing causes leaf spotting, wilting, stunting, central stem tip death causing multiple branches or crowns, and death of the whole plant.
- Host: mustard family: broccoli, cabbage, cauliflower, kale & weeds.
- Adults are most active **during warmer times of the day (near or above 80°F)**.
- Management/Adaptation:
 - Spring weed host control
 - Pesticides: pyrethroid, organophosphate, carbamate, or neonicotinoid insecticides.



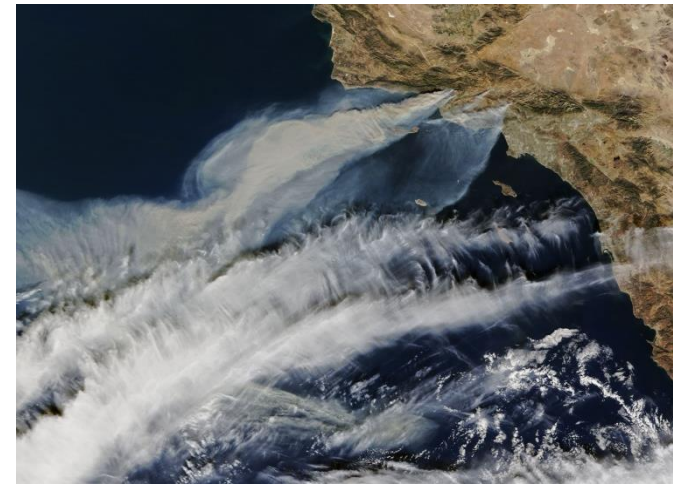
Emergency Adaptation for Disasters

“Communities were protected by a wide buffer of fire-resistant, irrigated avocado and citrus orchards. And in those orchards, as the flames advanced, an army of hundreds of farm employees, managers and owners waged a desperate and largely unseen battle to save ranch homes, trees, fruit and equipment.

Their efforts helped protect adjacent residential neighborhoods by ensuring that the fire died when it hit those orchards, instead of racing through them. **Farm employees cut firebreaks with bulldozers. They drove water trucks and manned hoses to hold the fire on the grove perimeter. They tamped out interior spot fires with shovels and backpack sprayers.** Sometimes they had help from professional fire crews. Often, they did not.”

Quote from:

<https://www.vcstar.com/story/opinion/columnists/2018/02/10/orchard-s-farmers-played-key-role-thomas-fire-fight/325096002/>



Thomas Fire:

- 39 days (Dec 17- Jan18)
- 281,893 acres (114,000 ha)
- 22 deaths (2 fire/ 20 debris flow)
- 100,000 people evacuated
- 1,063 Structures Destroyed, 280 Damaged
- \$297M cost

Other adaptive strategies?



“Reza por la lluvia”

Mitigation

- Energy: solar, wind
- Farmland conservation
- Soil C sequestration



Cenergy Power Completes 1MW Solar Array for Rio Farms

on April 27, 2016 at 9:33 am

Cenergy Power (Cenergy) announced today the completion of a 1MW DC ground-mount photovoltaic (PV) system for Rio Farms, in King City, CA. The solar system is expected to generate enough

“Investing in solar is really an investment in our company and community. We’re effectively locking in our electricity prices for the next few decades while simultaneously reducing our impact on the environment.”

– David Gill, Owner Rio Farms

Summary

- Successful farmers have always adapted to weather and market challenges, now climate requires additional planning.
- Continued temperature records, droughts and natural disasters are impacting crop production in California
- Adaptations are interrelated but can be specific to crops, water security, pest pressure and disasters

Thank You!

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